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# Grading and Measuring Hickory Trees, Logs, and Products

by Allyn M. Herrick



*In cooperation with*  
Southeastern Forest  
Experiment Station  
Forest Service-U.S. Dept. of Agriculture

## FOREWORD

Hickory (*Carya* spp.) has earned the reputation of being one of the world's toughest woods. In shock resistance it has no equal. The reputation earned by hickory is based on the performance of high quality material in products requiring a high degree of strength and toughness.

Today, a limited quantity of high-grade hickory is available and its value and scarcity are well recognized by the wood-using industries. There is, however, a large volume of low-grade hickory that was bypassed when loggers cut our hardwood forests, and many land managers are troubled by the increasing amount of growing space occupied by it. Although this low-grade hickory does not possess the quality or properties required in many products, it is a potentially valuable wood for many uses.

A conference of federal, state, university, and industrial representatives was held in Clemson, S. C., in April 1953, and the Hickory Task Force was organized to promote the utilization of hickory. Accomplishment of this objective will be reached through research and publication of known information.

The Southeastern Forest Experiment Station has assumed the responsibility to edit, publish, and distribute reports containing information which will be developed under this program.

Full acknowledgment is due the many cooperating agencies and individuals who are making the project possible. Subject Matter Committee Chairmen are:

John Drow, Forest Products Laboratory, Madison, Wis., Growth and Properties of Hickory.

Roger Anderson, Duke University, Durham, N. C., Enemies of Hickory.

Roy M. Carter, N. C. State College, Raleigh, N. C., Manufacturing and Seasoning of Hickory.

John W. Lehman, Tennessee Valley Authority, Norris, Tenn., Products from Hickory.

Lenthall Wyman, N. C. State College, Raleigh, N. C., Hickory for Fuel.

C. E. Libby, N. C. State College, Raleigh, N. C., Hickory for Fiber.

Monie S. Hudson, Spartanburg, S. C., Treating Hickory.

Richard D. Lane, Northeastern Forest Experiment Station, Upper Darby, Penna., Marketing of Hickory.

Walton R. Smith, Chairman  
Hickory Task Force

See the inside back  
cover for a list of  
hickory reports planned.

# GRADING AND MEASURING HICKORY TREES, LOGS, AND PRODUCTS

by

Allyn M. Herrick, Dean<sup>1/</sup>  
George Foster Peabody School of Forestry  
University of Georgia  
Athens, Georgia

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## SUMMARY

There are no accepted standard grading systems specifically for hickory trees, logs, or bolts, but grading systems developed by Purdue University and the U. S. Forest Service are applicable for most hardwood species in the temperate zone and appear to be suitable for hickory. Lumber grade yields have been determined for a limited number of hickory trees and logs and are presented herein. Hickory product grades used by industry are also presented.

The major problem in the utilization of hickory is not with high-grade products such as ski stock, picker sticks, handles, etc., since there is a constant, strong demand for these items. The big problem is the utilization of the vast quantity of low-grade hickory. Continued demand for the high-grade hickory trees has left many of our forests with a preponderance of low-grade hickory trees that find little use and continue to increase in number and volume. Accurate grading systems can be the key to the utilization of this material, particularly if applied in the standing tree. By being able to classify hickory trees for specific uses, logging operations can be integrated for a variety of products and permit the hickory to be channeled into the proper lines of commerce.

This report is a starting point on hickory grades. It is hoped that other research workers and industry will be inspired to further the effort.

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<sup>1/</sup> Report prepared while Professor of Forest Management, Purdue Agricultural Experiment Station, Lafayette, Indiana.

## INTRODUCTION

There is no fundamental difference between the grading and measuring of hickory trees and logs and those of other species and species groups. However, bolts and billets of hickory that are produced for the handle industry or other secondary industries do have specifications that are more or less unique. And, in limited instances, other primary products of hickory are graded and measured in a novel manner. Thus the following pages include descriptive and tabular material both of general utility and for specific application to hickory.

### MEASUREMENT OF TREES AND LOGS

Log rules in International ( $\frac{1}{4}$ -inch kerf), Scribner, and Doyle scales are all used in estimating board-foot volumes for hickory logs. Log scaling is basically unaffected by species and is not discussed herein. However, since the Doyle log rule is used almost exclusively as the commercial scale throughout the principal hickory-producing areas of the United States, it is presented in table 1.

Table 1.--Log scale Doyle rule <sup>1/</sup>  
(Volume in board-feet)

Top d.i.b. (inches)	Log length in feet				
	8	10	12	14	16
8	8	10	12	14	16
10	18	22	27	32	36
12	32	40	48	56	64
14	50	62	75	88	100
16	72	90	108	126	144
18	98	122	147	172	196
20	128	160	192	224	256
22	162	202	243	284	324
24	200	250	300	350	400
26	242	302	363	424	484
28	288	360	432	504	576
30	338	422	507	592	676
32	392	490	588	686	784
34	450	562	675	788	900
36	512	640	768	896	1,024
38	578	722	867	1,012	1,156
40	648	810	972	1,134	1,296

<sup>1/</sup> Adapted from Schnur and Lane (8).

Except for pecan, hickory is largely an upland, dry-site species group, and because of its deep root system and the accompanying habit of growth, the hickory group is characterized as full-boled, with relatively little butt-log taper. Because of the thick bark in some species, the butt-log form quotient (Girard form class) for the group probably averages around 0.78.

Tables 2, 3, and 4 give estimated tree volumes in board-feet of hickory species in three different geographic areas and in two different scales. The author of the Lake States and the Kansas tables, S. R. Gevorkiantz (2), indicates, "The trees in the Lake States region have a slightly better form class (0.79) because of the slightly thinner bark and less pronounced butt-swell. The form class of the Kansas trees averaged around 0.78...hickories there (Kansas and Missouri) generally ran much larger in diameter but less in merchantable height than the northern hickories." The volumes in table 4 for the Ohio trees are somewhat lower than those for the Lake States hickories.

Table 2.--Volume tables for hickories,<sup>1/</sup> Wisconsin and Michigan

SCRIBNER SCALE						
D.b.h. (inches)	Merchantable height above stump in feet <sup>2/</sup>					Basis (trees)
	10	20	30	40	50	
- - - - - <u>Volume in board-feet</u> - - - - -						
10	21	40	55	65	--	18
12	36	62	83	98	114	32
14	51	88	118	142	168	15
16	--	118	159	196	230	3
18	--	--	201	256	300	--
Basis (trees)	11	28	24	5		68

INTERNATIONAL ( $\frac{1}{4}$ ) SCALE						
10	26	47	63	75	--	18
12	43	73	98	116	134	32
14	60	102	136	166	194	15
16	--	129	178	226	263	3
18	--	--	227	288	338	--
Basis (trees)	11	28	24	5		68

<sup>1/</sup> Compiled for use in the Forest Survey of the Lake States (6).

<sup>2/</sup> Volume above stump to usable top, i.e., the point on the stem at which merchantability for sawtimber is limited by branches, deformity, defect, or by a diameter of less than 8.0 inches. Stump height: 1 foot up to 18 inches d.b.h.; 2 feet over 18 inches d.b.h.



Table 3.--Volume table for hickories,<sup>1/</sup> Kansas

D.b.h. (inches)	Merchantable height above stump in feet <sup>2/</sup>				Basis (trees)
	10	20	30	40	
-- <u>Volume in board-feet, Scribner scale</u> --					
10	17	33	--	--	5
12	30	53	--	--	4
14	47	81	108	--	8
16	65	111	150	--	6
18	80	138	190	242	8
20	98	177	243	308	10
22	122	219	303	378	5
24	148	268	369	457	3
26	177	322	440	538	1
28	212	367	510	633	2
30	--	423	586	730	--
32	--	484	670	834	1
Basis (trees)	18	26	8	1	53

<sup>1/</sup> Compiled from data collected in the Forest Survey of Kansas.

<sup>2/</sup> Volume above stump to usable top, i.e., the point on the stem at which merchantability for sawtimber is limited by branches, deformity or defect. Stump height: 0.9 to 3.5 feet, with an average of 1.8 feet.

Table 4.--Volume table for shagbark, pignut, and bitternut hickories,<sup>1/</sup> Ohio

D.b.h. (inches)	Merchantable height in 12.3-foot logs				Basis (trees)
	1	2	3	4	
-- Volume in board-feet, International ( $\frac{1}{4}$ ) scale --					
10	27	47	65	--	14
12	41	71	99	126	31
14	58	102	141	179	24
16	79	138	192	243	18
18	--	181	251	318	14
20	--	230	320	405	7
22	--	--	398	504	4
24	--	--	--	614	0
26	--	--	--	738	1
28	--	--	--	875	0
Basis (trees)	26	24	50	13	113

<sup>1/</sup> Adapted from a table prepared by Emmer (4). Trees measured by J. W. Girard in 2-inch diameter classes and 10-foot to 16-foot log lengths and scaled as such.



Percentage overrun from three log rules (Doyle, Scribner Dec. C., and International  $\frac{1}{4}$ -inch) is shown in table 5. Although limited in basis, the overrun data are representative for the given range in log size.

Table 5.-- Percentage overrun from three scale rules for hickory,<sup>1/</sup> Indiana

Log d.i.b. (inches)	Average percentage overrun from--			Basis (logs)
	Doyle rule	Scribner Dec. C. rule	International ( $\frac{1}{4}$ ) rule	
11	82	49	18	1
12	67	40	14	2
13	54	33	12	5
14	44	27	10	7
15	36	22	8	4
16	30	19	6	5
17	25	15	4	2
18	20	12	3	2
19	16	9	1	0
20	12	6	0	2
21	9	3	- 1	1
All sizes	31	18	6	31

<sup>1/</sup> Original data collected by Purdue A.E.S. Based upon 4,390 board-feet, mill tally, of sound logs only.

Volumes of trees in handle bolts and added saw log-volumes are shown in table 6. The scale of bolts is shown in both board-feet and in total inches of diameter (inside bark) at the small end of the bolts. Standard bolt length is 40 inches, and the minimum top diameter is 7 inches.

## GRADING OF TREES AND LOGS

Two sets of log grading rules are presented. The Purdue grades define quality by reference to the proportion of the "cylindrical" segments of the log that are clear of external evidence of defect. The Forest Service Standard Grades for Factory Logs (table 7) are based upon the amount and length of "clear cuttings" on the three best "grading faces." As with log rules, these grades are not specifically for hickory logs, but were designed to be applied generally to all species of hardwoods.

Table 6.--Yield of hickory handle bolts and additional saw logs, by tree d.b.h., Missouri <sup>1/</sup>

Tree d.b.h. (inches)	Basis: number of trees	Gross volume <u>2/</u> and number of handles <u>3/</u> by number of 40-inch bolts <u>4/</u>										Saw log volume above bolts in tree <u>4/</u>					Cull <u>5/</u>
		1 bolt		2 bolts		3 bolts		4 bolts		5 bolts		1	2	3	4	5	
		Volume or handles		Volume or handles		Volume or handles		Volume or handles		Volume or handles							
		Board- feet	Number	Board- feet	Number	Board- feet	Number	Board- feet	Number	Board- feet	Number						
		----- Board-feet -----															
12	19	10	or 9	20	or 18	26	or 25	34	or 33	42	or 41	19	12	9	0	0	8
14	11	16	or 10	26	or 20	44	or 30	57	or 39	70	or 49	37	31	19	11	4	11
16	10	23	or 12	39	or 24	54	or 34	70	or 45	86	or 55	59	51	44	37	29	10
18	5	31	or 13	54	or 27	77	or 39	100	or 52	104	or 63	87	74	63	53	62	9
20	5	41	or 16	71	or 31	104	or 45	135	or 59	144	or 72	113	98	82	68	82	9
22	5	46	or 17	91	or 33	135	or 49	154	or 64	166	or 78	145	119	98	109	139	9
24	3	57	or 18	113	or 37	170	or 54	197	or 71	216	or 87	135	157	135	151	184	8
26	1	69	or 20	138	or 40	209	or 60	245	or 78	272	or 95	237	209	174	207	256	8

<sup>1/</sup> Adapted from table prepared by the U. S. Forest Service and modified to apply to Reynolds County, Mo., trees.

<sup>2/</sup> Saw log and bolt volumes determined by the Scribner scale.

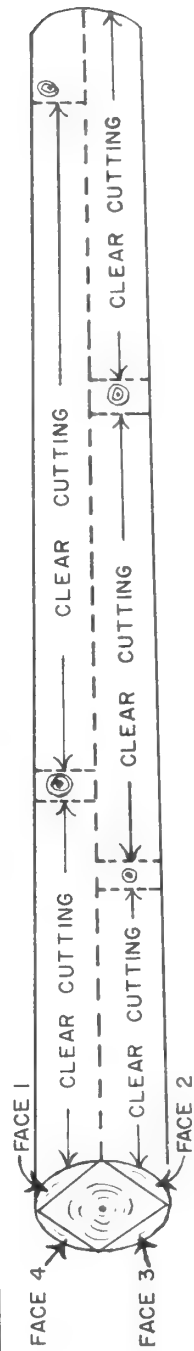
<sup>3/</sup> Yield of 10.5 handles per board-foot scale. All bolt d.i.b. measurements in inches at the small end.

<sup>4/</sup> Bolts from trees of 18 inches d.b.h. and under on a one-foot stump; bolts from trees of 20 inches d.b.h. and over on a two-foot stump. Bolts taken from trees with minimum top d.i.b. of 7 inches. Saw logs above bolts cut to a minimum top d.i.b. of 10 inches with a minimum length of 8 feet.

<sup>5/</sup> Cull based on log-scale measurements at logging operations.

Table 7.--Forest Service standard grades for factory logs (12)

Grade factors	Log grade 1		Log grade 2	Log grade 3
	Butts only	Butts and uppers	Butts and uppers	Butts and uppers
DIAMETER (minimum)	13"-15"	16"-19" ; 20"+	11	8"+
LENGTH (minimum)	10'+	10'+	8'-11' ; 12'+	8'
CLEAR CUTTINGS (on the 3 best faces)				
Length (minimum)	7'	5' ; 3'	3'	2'
Number on face (maximum)	2	2	2 ; 3	Unlimited
Yield in face length (minimum)	5/6	5/6	4/6	3/6
SWEEP AND CROOK DEDUCTION (maximum)	15%	15%	30%	50%
CULL DEDUCTION, including sweep (maximum)	40%	40%	50%	50%
SOUND END DEFECTS, area (maximum)	---See instructions---			



Exceptions.--In ash and basswood 12" d.i.b. for grade 1 butts.

Grade 2, 10" d.i.b. must be grade 1 surface quality.

Grade 2, 11" d.i.b. limited to two cuttings.

Grade 2, 8' and 9' lengths limited to 12" d.i.b.; 3/4 yield in not more than two 3' cuttings.

Sweep and crook allowance reduced 1/3 in logs with more than 1/4 diameter in sound end defects.

Sixty percent cull deduction permitted in grade 2 if otherwise of grade 1 quality.

Sixty percent cull deduction permitted in grade 3 if otherwise of grade 2 quality.

## Purdue Hardwood Log Grades (5)

- |        |   |
|--------|---|
| Prime  | Practically (90 percent) surface clear in one cutting on "three visible faces." <sup>2/</sup> Must be 16 inches or larger in d.i.b.   |
| No. 1  | At least three-fourths (75 percent) of length on three visible faces must be surface clear in one cutting. <sup>3/</sup> Must be at least 14 inches d.i.b.                                    |
| No. 2  | At least one-half (50 percent) of length on three visible faces must be surface clear in one or two cuttings, neither of which is less than 3 feet long. Must be at least 10 inches in d.i.b. |
| No. 3. | Will not meet No. 2 specifications.   |

Tree grading systems suitable for use with hickory have been reported by Campbell (3) and Herrick (5). These systems rely upon the identification of the grades of one or more logs in each tree.

Campbell's system applies the Forest Service Standard Grades for Factory Logs to the butt log only, and suggests their application to just one predetermined grading face ( $90^{\circ}$  of the tree circumference). The tree grades are designated as "A," "B," and "C," corresponding with butt log grades of F1, F2, and F3, respectively (table 8).

Tree grade, as defined by Herrick, is the unweighted, arithmetic average of the (Purdue) grade numbers of all of the logs in the tree, prime logs being called "zero." Thus a three-log tree containing a prime, a No. 1, and a No. 2 grade log would have a tree grade of 1, ( $0 + 1 + 2 = 3$ ;  $3 \div 3 = 1$ ). Since the log grades apply to that portion of the tree facing the observer, and are quite simple in definition, the trees may be graded from a single position, if desired.

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<sup>2/</sup> The "three visible faces" concept, as introduced by the late James W. Girard and as used in the Purdue log grades, refers to the portion of the tree visible to an observer from one position and includes evidences of protruding defects, such as limb stubs or branches, even though their bases are not visible to the observer.

<sup>3/</sup> A cutting is the length between surface indications of a sound or unsound defect.

Table 8.--Tree grades for Appalachian hardwoods <sup>1/</sup>

Tree grade	FPL butt-log grade	D.b.h. class		Clear cuttings on grading faces <sup>2/</sup>			Maximum defect	
		Usual	Minimum	Maximum	Minimum single	Length total	Sweep and crook	Total cull <sup>3/</sup>
		-- Inches --		Number		-- Feet --	-- Percent --	
A	1	18+	<sup>4/</sup> 16	2	7	13	15	40
			18	2	5	13	15	40
			24	2	3	13	15	40
B	2	16+	12	2	3	11	30	50
			14	3	3	11	30	50
C	3	12+	10	8	2	8	50	50

<sup>1/</sup> Based on quality of the first 16.3-foot length above the stump or jump butt, if any. After Campbell (3).

<sup>2/</sup> This is the right-hand face of the 2 faces seen as the tree is approached.

<sup>3/</sup> Total cull including crook and sweep. See Lockard, et al., (7) for type of defect and cull estimates.

<sup>4/</sup> Ash and basswood only will admit 14-inch trees.

#### LUMBER GRADE YIELDS, QUALITY INDICES, AND OVERRUN

Hickory lumber is graded according to the National Hardwood Lumber Association (NHLA) rules, with Number 3A Common and Number 3B Common characteristically being kept separate. Table 9 shows percentage grade recovery figures by log diameter for some 11,000 board-feet of hickory sawed at mills in the Tennessee Valley Authority area. The table covers all grades of logs and is segregated according to FPL log grades for factory lumber. Table 10 shows grade yields for different log diameters of hickory logs which were sawed in Indiana. The basis is between 5,000 and 6,000 board-feet, mill tally.

Relative grade yields according to Forest Service Standard Grades for Factory Logs, with all sizes pooled, are in table 11. They are based on about 31,000 board-feet of mill tally.

Table 12 includes quality indices (QI's) for hickory based on standard price relatives. Quality indices are proportional to the dollar values of the lumber in the logs (5). The QI's are shown according to log diameter, regardless of log grade, and according to Purdue log grade when log sizes are pooled.

Campbell (3) has developed tree QI's for Appalachian hickory by tree grade and diameter, for trees having one, two, or three logs (table 13).

Table 9. -- Averaged grade yields for hickory in the TVA area <sup>1/</sup>  
(Standard hardwood lumber grades, in percent)

D.i.b. (inches)	All grades of log <sup>2/</sup> (Basis: 176 logs; 10.8 M board-feet)					Grade F1 logs (Basis: 6 logs; 0.7 M board-feet)					Grade F2 logs (Basis: 35 logs; 2.6 M board-feet)					Grade F3 logs (Basis: 103 logs; 6.2 M board-feet)				
	FAS	1C&Sel.	2C	3AC	3BC	FAS	1C&Sel.	2C	3AC	3BC	FAS	1C&Sel.	2C	3AC	3BC	FAS	1C&Sel.	2C	3AC	3BC
8	0	5	10	11	74	--	--	--	--	--	--	--	--	--	--	0	10	12	14	64
10	2	17	21	21	39	--	--	--	--	--	--	--	--	--	--	2	15	23	21	39
12	4	22	27	24	23	--	--	--	--	--	6	23	19	22	30	4	16	32	27	21
14	4	23	32	25	16	8	45	28	15	4	8	29	20	22	21	4	16	39	30	11
16	5	23	32	28	12	27	51	12	9	1	9	33	21	21	16	4	16	43	32	5
18	5	23	33	28	11	37	50	6	6	1	9	36	24	17	14	4	16	46	32	2
20	5	24	32	28	11	40	49	4	6	1	9	38	25	14	14	4	16	47	32	1
22	5	24	32	28	11	40	49	4	6	1	9	39	27	12	13	4	16	49	30	1
24	5	24	32	28	11	40	49	4	6	1	9	39	29	10	13	4	16	50	29	1
All sizes	3	<sup>3/</sup> 20	29	21	<sup>4/</sup> 27															

<sup>1/</sup> Curved from original data supplied by Paul Lane.

<sup>2/</sup> Includes 35 logs that are below Grade 3.

<sup>3/</sup> Includes 0.6 percent of sound-wormy.

<sup>4/</sup> Includes 14.7 percent of ties and timbers.

Table 10. -- Average lumber grade yields for hickory <sup>1/</sup>  
(In percent)

Lumber grade	Log diameter inside bark in inches							
	12	14	16	18	20	22	24	
FAS	6	13	18	21	23	24	24	
1C&Sel.	20	32	38	40	41	42	42	
2 Com.	23	28	26	24	23	22	22	
3 Com.	51	27	18	15	13	12	12	

<sup>1/</sup> Adapted from Herrick (5), Table D-3.

Table 11. -- Actual lumber grade yields for hickory <sup>1/</sup>  
(In percent)

Log grade	Standard hardwood lumber grades				
	FAS	Sel.	1C	2C	3C
1	25.2	3.1	36.5	20.6	14.6
2	5.6	1.5	32.8	39.0	21.1
3	.7	.3	13.4	49.8	35.8

<sup>1/</sup> Adapted from Forest Products Laboratory (12).

## MEASUREMENT AND GRADING OF OTHER PRIMARY PRODUCTS

Hickory is used for the manufacture of many specialty items such as skis, softball bats, and sucker rods (1). Specifications vary from industry to industry and from one manufacturer to another within a given industry, so

Table 12.--Average quality indices for hickory in Indiana, <sup>1/</sup> according to log diameter and log grade

Diameter or grade	Quality index
	Percent
D.i.b.	
12 inches	65
14 "	79
16 "	85
18 "	89
20 "	90
22 "	91
24 "	91
Purdue grade	
Prime	91
1	83
2	74
3	67

<sup>1/</sup> Adapted from Herrick (5), Tables D-4 and D-6. Price relatives: FAS, 1.4; 1C&Sel., 1.0; 2C, 0.6; 3C, 0.4.

that it is almost impossible to set down standards. The handle industry, however, has grades and specifications that permit generalization.

### Handle Blocks and Blanks

Hickory handle blocks are commonly bought and sold on the basis of the handle "count" for various diameters (fig. 1). Sometimes bolts are measured by the standard cord of 128 cubic feet. A pile 4 feet high by 10 feet long of 40-inch handle bolts equals one cord, approximately. Table 14 shows the number of handles obtainable from blocks of different diameters.

Table 13.--Quality indices for Appalachian hickory <sup>1/</sup>  
(In percent)

D.b.h. (inches)	1-log trees			2-log trees			3-log trees		
	Grade A	Grade B	Grade C	Grade A	Grade B	Grade C	Grade A	Grade B	Grade C
12	--	--	43	--	--	41	--	--	40
14	93	71	47	78	59	45	67	55	44
16	97	75	51	81	63	49	71	58	48
18	101	79	55	84	67	53	75	62	52
20	105	83	59	88	71	57	78	65	56
22	108	87	63	92	75	61	82	70	60
24	112	91	67	95	79	65	86	74	63
26	116	95	72	98	83	69	89	77	67
28	120	99	76	102	87	73	93	81	71
30	124	103	80	105	91	77	97	85	75

<sup>1/</sup> Adapted from Campbell (3), Table 6.





Photo courtesy Purdue A. E. S.

Figure 1.--Hickory handle blocks (foreground) and handle blanks (rear) at an Indiana factory.

Table 14.--Handle scale or handle count<sup>1/</sup>

Top d.i.b. of block (inches)	Handle count
	<u>Number</u>
7	3
8	4
9	6
10	7, 8
11	9
12	10-12
13	14
14	14-16
15	17
16	18-19
17	20
18	20-22
19	24

<sup>1/</sup> Original data collected by Purdue  
A. E. S.

Prejudice against red hickory has been built up in the past because of the association of red heartwood with slow-growth, mature trees. It is the slow growth, and the accompanying low percentage of summerwood and low density that are detrimental to the strength properties of hickory, not the red color. Exhaustive tests by the Forest Products Laboratory (11) show that, "weight for weight, sound hickory has the same strength, toughness, and resistance to shock, regardless of whether it is red, white, or mixed red and white."

The density of hickory is the best clue to its strength. Thus, for a given size of piece, grading (for strength) may be accomplished by weighing. Similarly, evidences of strength (density) may be obtained by determining the number of

growth rings per inch. Standards maintained by many handle-manufacturing concerns are such that wood showing more than 20 growth rings per inch is not acceptable for high-grade handle blocks.

Grades for hickory blocks that are representative of those used by mid-western and southern handle companies are given below:

Typical Grades and Specifications for Hickory Handle Blocks

Species accepted .....	Shagbark, mockernut and pignut or black hickory. Yellowbud or bitternut hickory is not acceptable for handles.
Minimum top d.i.b. ....	7 or 8 inches. Varies with company.
Length .....	38, 40, or 42 inches. Varies with company.
Grade No. 1 (or A) .....	Strictly clear blocks with at least 3 inches (or $3\frac{1}{2}$ , or 4 inches, depending upon the company) of white wood (sapwood) on the small end of the block.
Grade No. 2 (or B) .....	Generally clear blocks with less than the depth of white wood required of Grade No.1.
Grade No. 3 (or C) .....	Red blocks with less than 2 inches of white wood, or reasonably clean blocks but permitting small defects such as slight pecks, streaks, etc. Light weight may place blocks in this grade.

Grades and specifications for hickory handle blanks for the TVA area, as quoted by Smith (9), are essentially the same as those in use by an Indiana handle company:

Extra .....	Must be all white, heavy timber, free from all defects, perfect, full size, and straight grain.
No. 1 .....	Must be good weight timber, permitting one-third red wood the entire length of the blank. All-white blanks of good weight not sufficiently heavy for Extra grade, and blanks of good weight with two light hair streaks running the full length of the blank or their equivalent in shorter streaks are permitted. No. 1 blanks must be free from defects, full size, and straight grain.
No. 2 .....	Must be fair weight timber; permitting red, white, or red and white mixed wood; permitting light streaks and three tight, sound knots not over $\frac{1}{4}$ inch in diameter when occurring in that part of the blank other than will produce the center, or spring, of the handle. Reasonably straight grain is required.
No. 3 .....	Includes such blanks as will produce serviceable handles, but are not admissible to the higher grades on account of defects.
Reject .....	Are those containing open knots greater than $\frac{3}{8}$ inch in diameter, worm holes, windshakes, or that are brashy, and are not admissible to any grade.

Recommendations for standard grades for hickory striking tool handles are given on page 9, Hickory Task Force Report No. 6, and are reproduced again in the Appendix.

### Hickory Striking Tool Handles

The grading of handles is based upon visual inspection of each handle and on the judgment of the grader. It is not expected that the grader will determine the weight per cubic foot or number of rings per inch for each handle. In case of questions, however, one or both of these characteristics may be measured for conformance with the requirements given each grade.

Handles are manufactured from all commercial species of hickory. Weights are based upon a moisture content not exceeding 12 percent.

Blemishes.--These include small streaks--threadlike discolorations extending not more than one-third the length of the handle; medium streaks--discolorations extending more than one-third the length of the handle, but not over 1/32 inch in width; mismanufacture which does not impair the serviceability; and light stain--slight difference in color which will not seriously impair the appearance of the handle.

Defects.--These include knots; birdpecks; splits; holes; decay; stain; crossgrain--deviation of the fiber out of parallel with the axis of the handle in excess of 1 in 20; abrupt dip grain--deviation of the fiber out of parallel with the axis of the handle in excess of one-eighth the minimum diameter of the handle at the point where the dip grain occurs; slight dip grain--deviation of the fiber out of parallel with the axis of the handle point where the dip grain occurs; heavy stain--discoloration of the wood occurring in specks, spots, streaks, or patches of varying intensities of color (generally bluish-black); and large streaks--discolorations more than 1/32 inch in width.

### Hickory for Skis

Some producers in the Tennessee Valley have quoted specifications for ski blanks. Although varying in certain details, these specifications generally call for clear, straight-grained white hickory of the highest grade. The No. 2 grade is also clear but may be red on one side; No. 3 is clear but can be all red. The size (green) is typically 1½ inches by 4½ inches by 7 to 8 feet, with 2 or 3 inches of extra length allowed for trimming.

Wood to be used in laminated skis is described in specifications of the U. S. Department of Defense (10). For top and bottom sections the wood shall be true hickory (bigleaf shagbark, mockernut, pignut, or shellbark), weighing not less than 48 pounds per cubic foot at 12 percent moisture content. It must be clear and free of decay, splits, check, honeycomb, shakes, knots, holes and bark pockets, crossbreaks, case hardening, compression wood, brashness, doze, or any other defects affecting serviceability. Mineral streaks not more than one-eighth inch wide and not more than 12 inches long will be permitted. Slope of grain shall not exceed 1 in 15 on any face.

Hickory may also be used for the center section and filler plate in laminated skis. For this purpose the weight must be not less than 40 pounds per cubic foot at 12 percent moisture content, and the slope of the grain must not exceed 1 in 10 on any face. Wood shall be free of decay, splits, bark pockets, and unsound knots. Other defects will be limited as follows:

1. Sound tight knots not exceeding one-fourth inch in average diameter and located at least 6 inches apart.
2. Holes not exceeding one-sixteenth inch in diameter and at least 2 inches apart. Holes shall not appear on exposed edges.
3. Surface checks and shakes shall be limited to barely perceptible openings, not over 4 inches long and not appearing on exposed edges.
4. Sound mineral streaks will be permitted. Patching of defects in the center section with wood patches will be permitted, providing each patch is not less than 4 times as long as its greatest cross sectional dimensions and providing the ends of each patch are scarfed at a slope not exceeding 1 in 10. All joints of patches shall be tight and shall comply to the requirements for laminated joints of this specification. Patching shall be done before the center section is glued together.

### Hickory Poles and Bark

Manufacturers of rustic furniture purchase hickory poles and, in some cases, bark as raw materials. Small poles suitable for rungs are  $\frac{3}{4}$  to 1 inch in diameter. Larger poles, from  $1\frac{1}{2}$  to 4 inches in top diameter, are used for posts in the furniture. Lengths accepted vary from a minimum of 20 inches for rung stock at one plant to  $10\frac{1}{2}$  feet maximum at another. The poles must be cut during the winter so that the bark will remain tight. They are bought by the piece.

Bark of pignut (black) hickory is purchased by the hundred square feet of surface measure. In making strips for furniture seats and backs the bark is split, hence higher yields are realized from thick bark. The grade and price paid are higher, therefore, when the bark is thick. Bark is delivered and stored in rolls (fig. 2).



Photo courtesy Purdue A.E.S.

Figure 2.--Hickory bark is purchased by surface measure and is delivered and stored in rolls.

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## APPENDIX

### SIMPLIFIED PRACTICE RECOMMENDATION, HICKORY HANDLES

(The grading of handles is based on visual inspection of each handle and on the judgment of the grader. It is not expected that the grader will determine the weight per cubic foot or number of rings per inch for each handle. In case of question, however, one or both of these characters may be measured for conformance with the requirements given in this table for each grade.)

Grade symbol <sup>1/</sup>	Color of wood	Number of annual rings per inch of radius	Weight in pounds per cubic foot <sup>2/</sup>	Admissible blemishes <sup>3/</sup>	Admissible defects <sup>4/</sup>
AAW	All white	Not more than 17	Over 55 (heavy)	None	None
AW	All white	Not more than 22	Over 46 to 55 (medium)	Not exceeding 2 small streaks or their equivalent in shorter streaks	None
AR	Red or red-and-white	Not more than 22	Over 46 to 55 (medium)	Medium streaks	None
BW	White except for red extending from the eye end not more than 2 inches beyond the shoulder, or 3 inches from the grip end, or both.	Not more than 27	Over 46 to 55 (medium)	Not exceeding 4 medium streaks or their equivalent in shorter streaks. Light stain.	One or 2 bird pecks, or tight, sound knots the sum of whose average diameter does not exceed $\frac{1}{4}$ inch in the eye end or first third of the grasp end. Slight dip grain.
BR	Red or red-and-white	Not more than 27	Over 46 to 55 (medium)	Medium streaks Light stain	One or 2 bird pecks, or tight sound knots the sum of whose average diameter does not exceed $\frac{1}{4}$ inch. Slight dip grain.
C	Red or red-and-white	No requirement	38 to 46 (fair)	No requirement	Any or all those listed in footnote 4, provided none of them seriously impairs the serviceability of the handle.

<sup>1/</sup> Grade marking: If handles are grade marked it is recommended that the grade symbol be impressed in the wood.

<sup>2/</sup> These weights are based on a moisture content not exceeding 12 percent.

<sup>3/</sup> Blemishes include: Small streaks, threadlike discoloration extending not more than 1/3 the length of the handle; medium streaks, discoloration extending more than 1/3 the length of the handle, but not over 1/32-inch in width; mismanufacture which does not impair the serviceability; and light stain, slight difference in color which will not seriously impair the appearance of the handle.

<sup>4/</sup> Defects include: Knots, bird pecks, splits, holes, decay, stain, cross grain--deviation of the fibre out of parallel with the axis of the handle in excess of 1 in 20; abrupt dip grain--deviation of the fibre out of parallel with the axis of the handle in excess of 1/8 the minimum diameter of the handle at the point where the dip grain occurs; slight dip grain--deviation of the fibre out of parallel with the axis of the handle not in excess of 1/8 of the minimum diameter of the handle at the point where the dip grain occurs; heavy stain--discoloration of the wood occurring in specks, spots, streaks or patches of varying intensities of color (generally bluish black); and large streaks--discoloration more than 1/32 inch in width.



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